Séminaire de Biologie des Plantes

Les séminaires ont lieu sur le Campus Agro-M/INRA de La Gaillarde (2, place P. Viala Montpellier)

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Jeudi 27 mars 2008
Salle 106 (Cœur d'Ecole) à 14h00

Wendy K Silk
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Moving With The Flow
Analyzing Plant Growth and Environmental Interactions

Plant Growth Analysis. Like flames, waterfalls, and boat wakes, plant growth zones are structures composed of changing material particles. Thus to understand plant growth we must consider the Lagrangian (material or cell-particle-specific) as well as the obvious Eulerian (spatial) aspects of development. In general concepts and even numerical methods from fluid dynamics are useful for analyzing development. Growth can be specified using strain rate tensors, growth velocity fields, and particle pathlines. In a moving reference frame attached to the plant apex, steady (time-invariant) patterns of anatomy and biochemistry are apt to appear, corresponding to developmental gradients. Of the growth descriptors the strain rate field is particularly useful for quantifying environmental effects on growth. For example, temperature and water stress have been found to affect the spatial pattern of the strain rate differently, even when both environmental factors change the elongation rate by the same factor. Temperature affects the magnitude of longitudinal growth strain rates rather uniformly within the growth zone, while under water stress the growth zone shortens but longitudinal strain rates in apical regions are conserved. Water stress, but not temperature, decreases radial strain rates. Strain rates also appear in the relationship for growth-sustaining water potentials. The growth velocity appears in many interesting problems including determination of Lagrangian derivatives, stem curvature, biosynthesis rates, and cell division rates. The growth trajectory (particle pathline), a

Lagrangian specification, provides a space-time map and thus can be used to infer the time course of developmental processes. Perhaps because the growth trajectory is nonlinear, it is underutilized in plant science. It is useful to find the physiological significance of enzyme activation and gene upregulation.

Deposition rates in growing tissue. Data on growth velocity fields combined with experimental determinations of metabolite or cell density can be used with continuity equations to solve problems as varied as the physiology of osmotic adjustment in response to drought, and the molecular biology of cell division.

Root-soil Interactions. The soil-root system can be viewed from three different points of view: the stationary soil particle, the moving root tip, and the cellular particle moving with respect to both the root tip and the soil. Since the root is biologically active and has both selective uptake from and efflux to the soil, the root tip carries a chemical microenvironment as it penetrates the soil. If the developmental gradients are steady then a steady chemical field is produced around the growing tip. The size of the chemical boundary layer depends on the flux from the root surface and the Péclet number, that is, the ratio between root elongation rate and chemical diffusivity of the substance of interest. The spatial pattern of the chemical field can be related to the temporal pattern of chemical concentration experienced by the soil particles. I hypothesize that different niches for microbial colonization exist, corresponding to different modes of attachment to the root surface.

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SEMINAIRES A VENIR :

Jeudi 3 avril : Niko Geldner, Université Lausanne, contact Grégory Vert vertg@supagro.inra.fr

Jeudi 10 avril : Tou-Cheu Xiong (INRA Montpellier), contact xiong@supagro.inra.fr